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Influence of Concentrate Supplementation on Red Sokoto In-Does and Kid Weights in a Humid Tropical Environment

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Abstract **– A study was conducted to investigate the influence of concentrate supplementation on pre-partum weight of dam and kid birth weight of Red Sokoto goats maintained in a humid tropical environment. Nine in-does were completely randomized into three equal groups – 1, 2 and 3. Each group consisting of three animals were subjected to one of three different nutritional regimen from 9th week pre-partum to 20th week (point of parturition). Animals in group 1 (control) were maintained on forage sward only (Diet A). Group 2 and 3, were in addition, given concentrate supplementation formulated to contain 20.5% of palm kernel cake and bambara nut offal in the concentrate mix respectively. Animals in supplemented groups were fed concentrate diets at 3% of their body weight throughout the trial. Parameters measured included: Dry matter intake (DMI), Average Daily Gain (ADG), Feed Conversion Ratio (FCR) of in-does and birth weight of kids. The study revealed significant (P<0.05) effects of supplementation on ADG, FCR and birth weight of kids. ADG values ranged from 26.19g/d – 101.19g/d. Highest value of 101.19g/d was obtained from group 3 which was similar (P>0.05) to 74.41g/d from group 2 but significantly (P<0.05) higher than 26.19g/d of groups 1. FCR of 5.53, 1.62 and 1.36 were recorded for groups 1, 2 and 3 respectively. Birth weights of 1.48kg, 2.03kg and 2.34kg were obtained from kids of goats in groups 1, 2 and 3 respectively. Concentrate supplemented diets generally supported more weight gain and birth weight of kids. The present study therefore, underscores the relevance of concentrate supplementation of pregnant goats especially at the last lap of pregnancy which will help in the production of heavier kids with better vigor and survival rate which will go a long way to reduce kid mortality and solve the major problem of inadequate supply of animal protein to Nigeria populace.**

Keywords **– Concentrate, Supplementation, Red Sokoto, Birth Weight, Dam, Kid.**

I. INTRODUCTION

The success of any livestock production enterprise depends largely on adequate and qualitative nutrition. Majority of small ruminant farmers in Nigeria practice extensive system of management which does not ensure adequate feeding of stock. In northern Nigeria where most of the nation's livestock are concentrated, there is prolonged dry season (6-9 months) often causing serious feed shortages for animals. The situation is further aggravated by rapid deterioration in the nutrient quality of available pasture hence the basic nutritional requirements of animals during pregnancy and lactation are not met (Adu, *et al.*, 1979). In south-east Nigeria as well, farmers depend largely on natural pasture which varies greatly both in quality and quantity, depending on climatic condition and season, to sustain their animals.

Due to decline in feed resources offered by natural rangeland, majority of Nigerian small holder goat farmers resort to easily cheap and abundant crop-residues from post-harvest farm operations to augment nutrient resources derived by animals from depleting graze land. These crop residues are also in themselves limiting in basic nutrients for maintenance and production. This therefore makes supplementary concentrate feeding to boost the nutritional status of these animals imperative (Alawa and Umunna, 1993).

Red Sokoto goat is reported to have ability to tolerate harsh climates; they are suited to traditional systems on account of small size, short generation interval and ability to thrive on poor quality diets provided by scarce grazing on marginal lands (Steele, 1996; Ezimoha, 2011; FAO, 1991; Doma *et al*., 1999). However, mortality in this breed of goat is very high especially from birth to 30 days (Ezimoha, 2011, McGowon and Nurce, 2000).

Birth weight of kids is directly correlated to survivability (Rastogi *et al*., 2006; Husain *et al*., 1995 and Mtenga *et al.*, 1992). Improper nutrition before parturition negatively influences kid's weight, vigour and survival (Diego, 2007; Mude *et al.*, 2010). Also poor nutrition during pregnancy especially at the last three (3) months of pregnancy, causes longer post-partum interval, reduces milk production and induces a lot of physiological problems before, during and after parturition in goats (Mude *et al*., 2010). This study was therefore designed to assess the influence of concentrate supplementation on pregnant Red Sokoto goats and their kid weights, in a flock maintained in a humid tropical environment.

II. MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Sheep and Goat Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located within Latitude 5º 28' North, longitude

7º 32' East and on an altitude of 122m above sea level. The area falls within the tropical rainforest zone. Annual rainfall averages 2177mm. The monthly ambient temperature ranges between 20°C and 36°C, and relative humidity between 50 and 59%, depending on season (NRCRI, 2004).

Experimental Animals and Management

Nine Red Sokoto in-does, in their second parity and first month of pregnancy were isolated individually in pens and managed intensively. The animals were fed daily with forages (Table 1) in a cafeteria arrangement. Daily dry matter requirement of the animals were met by offering them fodder based on 5% of their body weight. Prior to their isolation, the animals were routinely dewormed and given acaricide bath.

Experimental Design and Parameters of Study

The nine in-does were randomly allotted into three (3) equal groups. Each group consisting of three animals were subjected to one of three different nutritional regimens (Table 1) in a Completely Randomised Design. Animals in Group 1 were maintained on basal forage sward only (Diet A). Groups 2 and 3, were in addition, given concentrate supplementation formulated to contain 20.5% of palm kernel cake and bambara groundnut offal, respectively, in a concentrate mix

Experimental diets

Three diets were used in this experiment. Diet A, the control, consisted of a forage sward made up of grasses, legumes and browse plants. Diets B and C had similar ingredients but were formulated to contain 20.5% of palm kernel cake and bambara groundnut offal, respectively. The forage and diets constituents and their proximate compositions are summarised in Tables 1. The concentrate diets were offered at the rate of 1.5kg per animal per day

Parameters of Study

The parameters of study were dry matter intake (DMI), feed intake, average daily gain (ADG), feed conversion ratio (FCR) of the in-does and birth weight (BW) of kids.

Duration of Experiment

The experiment lasted for 12 weeks. Feeding of experimental diets commenced on the 9th week pre-partum and ended on the 20th week in pregnancy (point of parturition)

Table 1: Constituents and Proximate Compositions of the Forage and Concentrate Diets

Constituents	**Diet A**	**Diet B**	**Diet C**
Palm kernel cake	*Forage sward	20.50	-
Bambaranut offal		-	20.50
Maize offal		33.50	33.50
Wheat offal		33.50	33.50
Brewers dry grain		10.00	10.00
Bone meal		2.00	2.00
Salt		0.50	0.50
Total		100	100
**Panicum maximum, Andropogon gayanus, Centrosema pubescens, Calapogonium Mucuniodes, Aspilia Africana, Maniphyton fluvum, Gmelina arborea*			
Analysed Compositions (%)			
Dry matter	50.72	90.52	90.15
Crude protein	7.92	19.17	20.29
Crude fibre	8.95	9.46	8.72
Nitrogen free extract	29.08	50.28	48.65
Ether extract	2.16	3.34	3.73
Ash	2.56	8.27	8.76
*Gross energy (MJ/KG)	2.26	3.90	3.89

- Calculated (Nehring and Haenlein, 1973)

Data Collection

Three kilograms of the forage sward was offered daily to each of the experimental animals in all the groups (1-3). In addition animals in groups 2 and 3 were offered in addition weighed quantities of diets B and C daily (1.5kg), enough to induce leftover and from where feed intake was subsequently determined. Weekly weights of in-does were taken from 9-20th week of pregnancy using a Salter hanging scale from which ADG and FCR were calculated. Birth weight of kids were taken within 24 hours post partum using a Camry Premium scale

Chemical Analysis

Proximate analysis of the concentrate diets and forage sward were carried out using A.O.A.C (1990) methods. The Gross energy of the experimental diets was calculated using the regression equation by Nehering and Haeluin (1973) as follows:

$Y = 5.72Z_1 + 9.50Z_2 + 4.79Z_3 + 4.03Z_4$ 0.9% where Y = Gross energy, Z_1 = Crude Protein, Z_2= Crude Fat, Z_3 = Crude Fibre, Z_4 = Nitrogen free extract.

Statistical Analysis

Data obtained from this study were subjected to Analysis of Variance Procedure (ANOVA) (Steel and Torrie, 1980) appropriate for Completely Randomized Design. Significant mean were separated using Duncan's Multiple Range Test (Duncan, 1955).

III. Results and Discussion

Experimental Diets

The proximate compositions of the diets used in this study are presented in Table 1 The energy and crude protein content of concentrate diets (B and C) were comparable but higher than that of control diet A. The crude protein content of the concentrate diets met the 14-18% range recommended for pregnant does and lactating animals in early lactation (NRC, 1981), hence the protein requirements of animals in groups 2 and 3 were adequately satisfied. However, animals in group 1 subsisted on a far less crude protein diet which nevertheless satisfied the minimum CP (7%) required for rumen motility and function (Milford and Minson, 1966).

Feed Intake and Performance of In-Does

The performance of Red Sokoto in-does fed the experimental diets is summarized in Table 2. Dietary effects on dry matter intake (DMI) were not significant (P>0.05). DMI ranged from 790.61 – 958.28g/d. Table 3 shows the weekly feed intake of pregnant does while figure 1 represents the trend in dry matter intake of in-does. Dry matter intake of 3.42 – 4.8% body weight obtained in this study is comparable to NRC (1981) recommended dry matter requirement (3.5 – 5.0%) for dairy goats. DMI peaked at week 15 of pregnancy and declined slightly thereafter between week 16 and 20.

Table 2: Performance of In-does fed Experimental Diets

	Diets			
Parameters	**A**	**B**	**C**	**SEM**
Mean Final weight(kg)	17.25[b]	22.75[b]	32.50[a]	2.62
DMI (g/d)	790.61	829.92	958.28	37.85
ADG (g/day)	26.19[b]	74.41[a]	101.19[a]	11.88
Average Birth weight	1.48[b]	2.03[a]	2.34[a]	0.14
FCR	5.53[a]	1.62[b]	1.36[b]	0.89

[a, b], means on the same row with different superscript differ significantly (P< 0.05).
SEM = Standard Error of the mean. ADG = Average Daily gain.
FCR = Feed Conversion Ration.

Table 3: Average Daily Dry Matter Intake (g) of Pregnant Does

	TREATMENTS			
WEEK	**A**	**B**	**C**	**SEM**
9	810.00	757.33	896.33	36.44
10	818.00	786.33	922.00	36.67
11	820.67	795.00	950.00	37.32
12	830.00	825.67	980.67	40.97
13	851.67	850.00	980.00	42.25
14	851.00	888.33	968.67	40.42
15	854.00	886.67	1029.33	33.11
16	765.33[b]	864.00[ab]	965.67[a]	39.40
17	730.00[b]	838.67[ab]	952.33[a]	42.47
18	730.00[b]	820.33[ab]	980.00[a]	43.75
19	716.67[b]	817.67[ab]	963.33[a]	47.59
20	710.00	829.00[ab]	911.00[a]	38.56

[a, ab, b], means on the same row with different superscript differ significantly (P< 0.05). SE = Standard Error.

The increasing DMI with advancing gestation, even up to the 14th week, could be due to physiological demand of the growing foetus. Subsequent decline of DMI after 15 weeks of gestation may be due to the profound and progressive enlargement of the womb due to the developing foetus, as well as the enlargement of uterine and supporting tissues which subsequently would have compressed portions of the alimentary canal thereby reducing feed intake and hence dry matter.

There was a significant (P<0.05) influence of feed supplementation during gestation on live weight of in-does. Concentrate supplements generally supported more live weight gain in this study than the control diet (A), with goats fed diet C (containing 20.5% Bambara groundnut offal) performing relatively better than the others. For instance, even though there were similarities (P>0.05) in average daily gain (ADG) and FCR values for goats fed diet B and C in this study (Table 2), goats fed diet C however, consumed less feed than those fed either A or B for each kilogram weight gain.

Fig.2 shows the weekly average body weight of in-does during the trial. In-does of supplemented groups (2 and 3) gained weight in a progressive manner throughout the duration of the experiment while does of unsupplemented group (1) recorded slight increase in weight during the 2nd trimester of pregnancy (beginning of the experiment) which was later lost at the last trimester of pregnancy. Similar observation was reported by Rastogi *et al*. (2006) for gravid goats. The findings of the present study, supported the view of Kumar (2003) who substantiated that nutrition during pregnancy is the most crucial to maintain dam's body growth and foetal organogenesis.

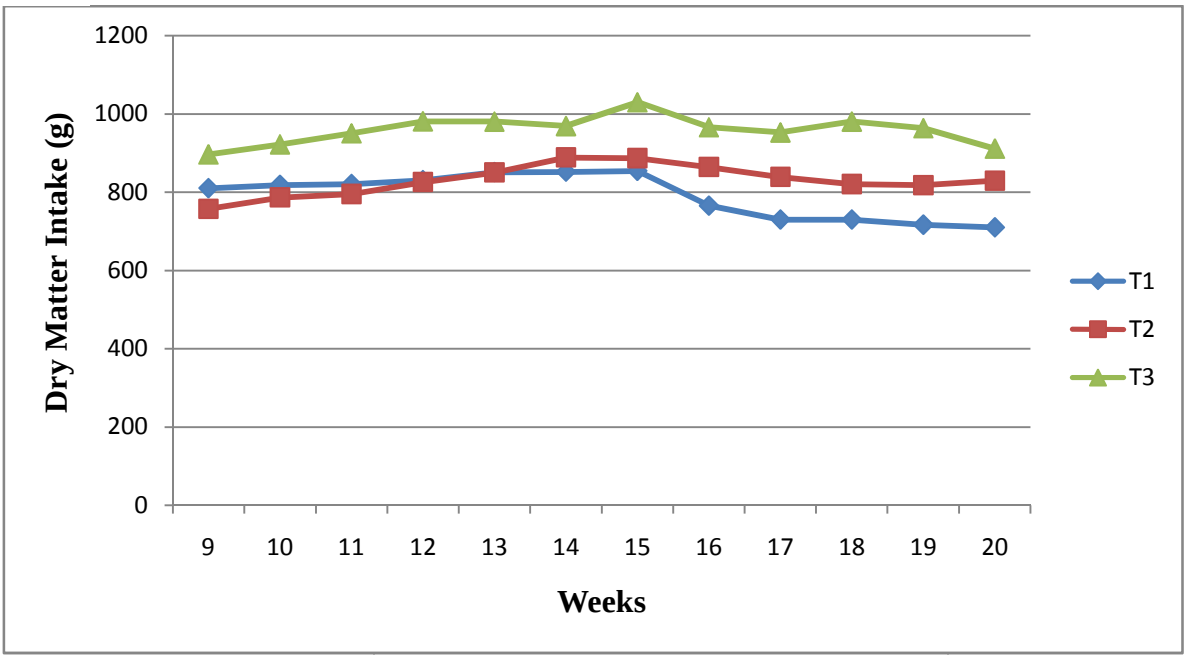

Fig.1. Weekly Trend of Daily Dry Matter Intake of Pregnant Does Subjected To Three Different Treatments

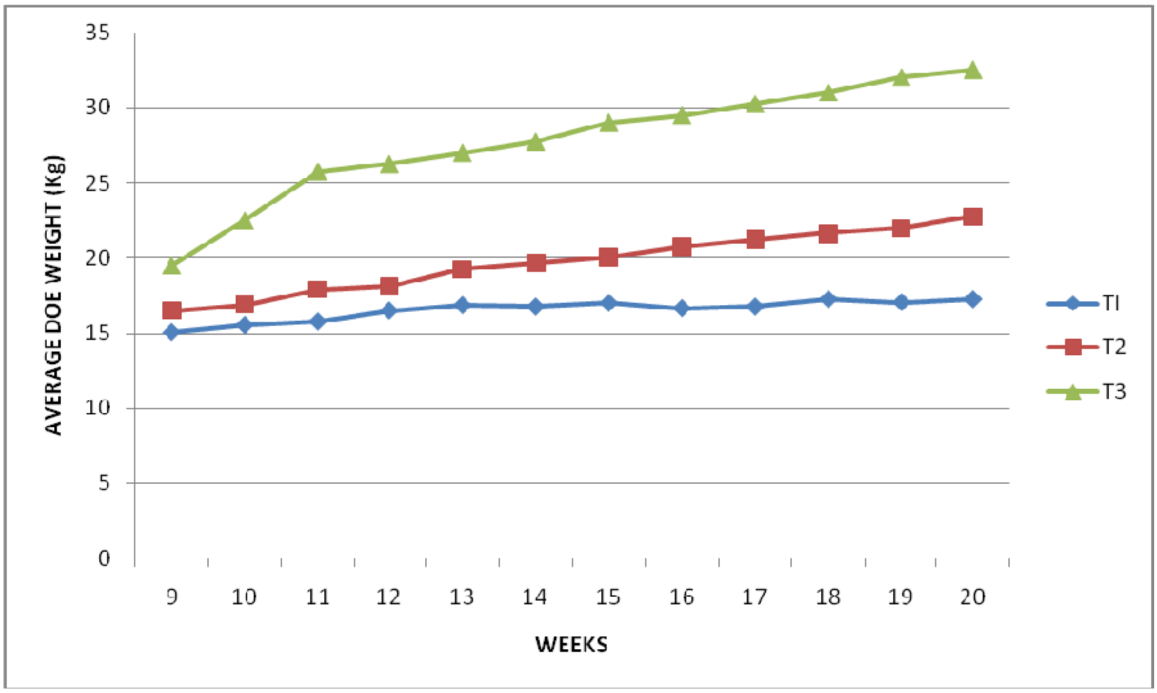

Fig.2. Weekly Trend of Average Body Weight in Pregnant Does Subjected To Three Different Treatments

It has been reported that during late pregnancy, there is preferential nutrient utilization for foetal growth at the cost of mobilization of maternal body tissues (Osuagwuh and Aire, 1990), which results in weight loss of doe if the dietary supply of nutrient is inadequate (Dayehn *et al*., 1996; Sibanda *et al*., 1997; Al-totanj and Lubbandeh, 2000).

Average Daily Gain (ADG) differed significantly ($P<0.05$) among treatment groups. ADG was least for goats in unsupplemented group and this differed significantly ($P<0.05$) from values obtained for goats in the supplemented groups (A and B); the latter though, did not differ significantly ($P>0.05$) from each other. The values of ADG obtained in the present study ranged from 26.19g/d in control group to 101.19g/day in group fed diet C. This observation compared favourably with the range of values (80 – 94.9g/d) reported by Olomola *et al*., (2008) for pregnant WAD goats fed groundnut cake, urea and rumen epithelial wastes in cassava flour and citrus pulp diets but higher than 32.44 - 53.88g/d reported for Red Sokoto goats supplemented with crop residue based rations during the long-dry period of the sub-humid zone in Nigeria (Malau-Aduli *et al*., 2004b).The highest ADG value of 101.19g/d obtained in this study was also higher than 64g/d reported for Pregnant WAD goat (Kirkpatrick and Akindele, 1974).

The non-concurrent results within breed can be attributed to differences in plane of nutrition, season of the year and level of supplementation. The higher values obtained in the present study is justifiable given the fact that it was conducted during the rainy season when naturally grazed pasture and feed resources are high in quality and quantity. This present study also suggests that increasing the level of supplementation (5% live body weight) gave better result compared to results (32.44 – 53.88g/d) of concentrate supplementation at 1% and 2% live body weight gotten elsewhere for Red Sokoto goats (Malau-Aduli *et al*., 2004b). Increasing the level of supplementation increases dry matter (DM) and crude protein (CP) intake as well results in increased availability and digestibility of other nutrients (Malau-Aduli *et al*., 2004b). The present study therefore, underscores the relevance of concentrate supplementation to pregnant goat especially at the last lap of pregnancy. This fact is in line with findings of earlier investigators (Rastogi *et al.*, 2006; Malau-Aduli *et al*., 2004; Olomola *et al*., 2008; Mude *et al*., 2010; Bajhau and kennedy, 1990 and Kumar, 2003).

Influence of Concentrate Supplementation on Kid Birth Weight

Table 2 shows the effect of concentrate supplementation during gestation on birth weight of kids. Does on diet C had the heaviest kids (2.34kg) at birth followed by kids whose dams were fed diet B (2.03kg). Does on control diet had the lightest kids at birth (1.48kg).

Weight of kids fed diet C were similar ($P>0.05$) to those given diet B but significantly ($P<0.05$) different from kids of dams fed diet A only (control). The range of values (1.48 – 2.34kg) obtained in the present study compared favourable with 1.9 – 2.2kg obtained for WAD goats in Nigeria (Olumola et al., 2008), 1.7 – 2.3kg for Gravid goats in India (Rastogi *et al*., 2006) and 1.25 -2.07kg for Red Sokoto Goat (Muktar *et al*., 2011) but higher than 1.07 – 1.4kg obtained for Red Sokoto goat in Nigeria (Malau-Aduli *et al*., 2004b). Meanwhile the mean birth weight value of 1.48kg obtained in the present study for goats on control diet is comparable to the mean figure of 1.58kg and 1.76kg reported for Red Sokoto goat by Ezimoha (2011) and Zahradden *et al*., (2008) respectively. The differences within breed can be attributed to variations in genetic and environmental factors. Environmental factors affecting birth weight of calves have been reported before now (Ibeawuchi, 1990b; Tyler *et al*., 1947; Ezimoha, 2011; Mwandotto, 1981). The higher values (2.03 and 2.33) obtained for the supplemented groups (table 4.2) relative to the unsupplemented group (1.48kg) revealed that concentrate supplementation of pregnant goats especially at the last lap of pregnancy leads to production of heavier kids. This observation is in line with the findings of Bajhau and Kennedy (1990). Increased level of dietary energy supplementation along with other nutrients from concentrate mixture might increase the availability and proper balance of nutrients to the host animal (in-does). This probably in turn may have resulted in higher supply of nutrients to the foetus and hence the reflected higher birth weight. However the results of this study contrasts the findings of Kochapakdee *et al*. (1994) and Muktar *et al*. (2011) who reported no significant effect of concentrate supplementation on birth weight. Higher birth weight (2.34kg) obtained from kids of goats fed diet C over those of goats fed diet B suggest the superiority of Bambara nut offal over palm kernel cake in supporting weight gain in Red Sokoto goat especially in South-eastern Nigeria.

In conclusion, the result obtained in this study revealed that concentrate supplementation of Red Sokoto in-does exerted strong influence on their reproductive performance. Higher average daily gain of 101.19 and 74.41g/d obtained from supplemented groups (C and B, respectively) against 26.19g/d obtained from unsupplemented group (A) underscores the relevance of concentrate supplementation of pregnant goats especially at the last lap of pregnancy.

Birth weight of farm animals has significant effects on lifetime yields hence higher birth weight of 2.03 and 2.34 obtained from supplemented group suggests that concentrate supplementation of in-does will help to increase over-all yield of chevron from one of Nigeria's indigenous small ruminant stock.

The study also showed that agro-industrial by-products like bambara and groundnut offals, in a palm kernel cake, maize offal, brewers dried grain and wheat offal concentrate mix, can be used as protein sources, to boost goat production in Nigeria considering their availability and non-competitiveness by humans.

Bambara nut offal based concentrate supplementation of pregnant goats led to the production of heavier kids with potentially better vigour and survival rate.

Adopting concentrate supplementation of in-does as a husbandry practice would go a long way to reducing kid mortality while enhancing animal protein supply to Nigeria populace.

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